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APPLICATION OF LIQUID UREA FERTILIZER TO LEAVES IN OPTIMIZING VEGETATIVE LEAF GROWTH IN PLANTS THAT HAVE NOT PRODUCED IN PTPN IV REGIONAL 1 RANTAU PRAPAT GARDEN

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Abstract

This study aimed to determine the effect of fertilizer application with a concentration of 5 grams per liter on the vegetative growth of immature oil palm plants (TBM). The study was conducted for 4 weeks with observation intervals once a week, using two treatments: control and application of 5 grams per liter fertilizer, each with 10 replications. Observed parameters included plant height, number of leaves, stem diameter, and leaf length. Data were analyzed using ANOVA test and continued with DMRT test at the 5% level. The results showed that the application of 5 grams per liter fertilizer had a significantly different effect on all growth parameters compared to the control in each observation week. This treatment consistently resulted in higher growth, so it can be concluded that the application of 5 grams per liter fertilizer is effective in increasing the vegetative growth of immature oil palm plants.

Keywords: TBM oil palm, liquid fertilizer, vegetative growth, PTPN IV Rantauprapat.

INTRODUCTION

The immature phase (TBM) of oil palm plants is a critical stage in the formation of vegetative structures that will determine plant productivity in the productive phase (TM) (Purnomo et al., 2020) . At this stage, plants require optimal vegetative growth to produce a strong canopy, an ideal number of fronds, and a sturdy trunk. These vegetative growth components will be the main capital in supporting the maximum photosynthesis process, thus supporting the formation of fresh fruit bunches (FFB) during the production period. Therefore, managing vegetative growth in the TBM phase is very important to ensure the plants have good yield potential in the future (Chisyashita, 2021) . Despite its importance, various obstacles remain in the field related to optimizing vegetative growth in TBM plants. Some common symptoms include slow leaf sheath growth, a small number of leaf sheaths, uneven leaf size, and pale leaf color (Saroha Manurung, 2022) . These conditions indicate a nutritional imbalance, particularly nitrogen (N), which is essential for the formation of leaves and other green tissue. If this problem is not addressed properly, the plants are at risk of experiencing suboptimal growth, thus affecting their productivity during the production phase (Sukmawan et al., 2016) .

Nitrogen is a fundamental macronutrient that supports the vegetative growth of oil palm plants. This element plays a role in chlorophyll formation, accelerating cell division, increasing leaf area, and strengthening the structure of the leaf sheath. (Halim, 2014) . Urea is the most widely used nitrogen source due to its high N content and relatively affordable price. Soil application of urea *has* become a common practice in plantations, but its effectiveness is often suboptimal under certain conditions (Siregar, 2023) . Several environmental factors and soil properties cause urea fertilizer to be less efficient when applied through the soil. In soils with high rainfall or rapid drainage, nitrogen tends to be leached, so the amount absorbed by plants is much lower than the dose applied. Furthermore, nitrogen can evaporate as a gas (*volatilization*) or be fixed by the soil, making it unavailable to plants. As a result, even when fertilizer is applied in sufficient quantities, plants still show symptoms of nitrogen deficiency, such as pale leaves and small leaf stalks (Triyono, et al. 2013) . *Foliar spray* application of liquid urea fertilizer is beginning to be considered as a more efficient fertilization alternative to address these issues. Foliar application allows nitrogen to directly enter plant tissues through the stomata and epidermis, resulting in a faster

growth response (Sukri et al., 2022) . This method can also reduce the risk of nitrogen loss due to leaching and increase fertilizer efficiency, especially in plants showing signs of nutrient deficiency. Therefore, the use of liquid urea can be a solution to accelerate vegetative growth in TBM oil palms (Susetyo, et al., 2022) . PTPN IV Regional 1 Rantau Prapat Plantation is a plantation unit that continuously strives to improve the growth quality of oil palm plants from the TBM to TM phase. Fertilization management is a priority program to ensure optimal plant growth and readiness to enter the production phase with maximum performance. However, the application of liquid urea fertilizer through leaves is still rarely implemented in the field, so its effectiveness and optimal dosage are not yet scientifically known in the context of local agro-climatic conditions. This represents a research gap that needs to be filled.

RESEARCH METHODS

Place and time of research

This research was conducted in the Immature Plants (TBM) area of PTPN IV Regional 1 Rantau Prapat Plantation with the following coordinates : 2.109° S (−2.109), 99.828° E (99.828) **.** The location was chosen because the plants were still in the active vegetative phase, making it suitable for testing the effectiveness of foliar urea liquid fertilizer. The research was conducted for approximately 3 months, starting from land preparation, treatment application, to observing plant growth.

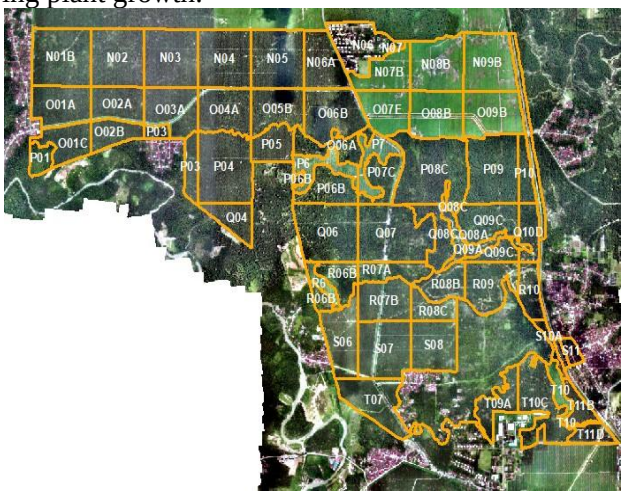

Figure 2 **:** PTPN IV Regional 1 Rantau Prapat Plantation

Tools and materials

This research used various supporting tools such as a hand sprayer for liquid fertilizer application, a plant height measuring tool, a caliper for measuring stem diameter, pliers or stakes as plot markers, measuring cups and buckets for mixing solutions, as well as stationery and a camera for recording and documentation purposes. The materials used included urea liquid fertilizer as the main foliar solution, clean water as a solvent, TBM oil palm plants as research objects, and other supporting materials needed during the research process.

Research methods

This research method used a field experiment approach, comparing two treatments: before and after treatment with a dose of 5 grams of urea per liter. The study was conducted on immature oil palm plants in divisions IV and V, with each treatment applied by spraying the plant's stomata.

Observation parameters

1. Plant height (cm) is measured from the base of the stem to the growing point.
2. The number of leaves (strands) is calculated for perfectly open leaves.
3. Stem diameter (cm) was measured using a vernier caliper at the base of the stem.
4. Leaf length (cm) was measured on active leaves representing vegetative growth. Observations were made every two weeks throughout the study period.

Data analysis

Data were analyzed using Analysis of Variance (ANOVA) at a 5% significance level to determine the effect of foliar urea liquid fertilizer on the vegetative growth of TBM oil palms. If a significant effect was found, the analysis was continued with Duncan's Multiple Range Test (DMRT) at 5% to compare between treatments.

Treatment. Observation parameters
U1. U2. U3
P0. P1 p0. P1
P1. P0. P1. P0

RESULTS AND DISCUSSION

Plant Height (cm)

Plant height is the length of a plant, measured from the base of the stem to the highest growing point. This parameter is used to determine the vertical growth rate of plants, as an indicator of vegetative development and response to fertilizer treatment. Based on the results of the ANOVA test, followed by the DMRT test, the results presented in Table 1 were obtained.

Treatment	Plant Height			
	1 MST	2 MST	3 MST	4 MST
control	126.1 b	127.5 b	128.9 b	130.2 b
5 grams per liter	129.9 a	135.7 a	141.6 a	149.1 a

Based on the DMRT test results on plant height parameters, it was seen that the treatment of 5 grams per liter of urea liquid fertilizer had a significantly different effect compared to the control in each observation week (1–4 WAP). This is indicated by the different letter notations in each column, where the 5 grams per liter treatment always received the notation a and the control received the notation b. On average, plant height in the urea treatment experienced a faster increase from week to week, namely from 129.9 cm at 1 WAP to 149.1 cm at 4 WAP, while the control only increased from 126.1 cm to 130.2 cm. This difference indicates that the foliar application of urea is able to significantly increase the height growth of TBM oil palm plants because the nitrogen element provided plays an important role in stimulating plant cell division and elongation.

Number of leaves (blades) Leaf number is the number of fully opened and actively functioning leaves on a plant. This parameter reflects the plant's ability to form photosynthetic organs and indicates the plant's growth rate and health. Based on the results of the ANOVA test, followed by the DMRT test, the results presented in Table 2 were obtained.

Treatment	Number of Leaves			
	1 MST	2 MST	3 MST	4 MST
control	9.45 b	9.75 b	10.03 b	10.33 b
5 grams per liter	10.65 a	11.89 a	13.16 a	14.55 a

Based on the DMRT test results on the number of leaves, the 5 gr per liter treatment showed a significantly different effect compared to the control in each week of observation (1–4 WAP), which is indicated by the difference in letter notation in each column . The 5 gr per liter treatment consistently obtained the notation a, while the control obtained the notation b, indicating that the treatment produced a significantly higher number of leaves. The average number of leaves in the 5 gr per liter treatment increased from 10.65 leaves at 1 WAP to 14.55 leaves at 4 WAP, while the control only increased from 9.45 leaves to 10.33 leaves. These results indicate that the application of fertilizer with a concentration of 5 gr per liter is able to increase optimal leaf formation, which is likely due to the availability of nutrients, especially nitrogen, which plays a role in the formation of plant vegetative tissue.

Figure 1. Spraying on Oil Palm Plants

Stem Diameter (cm)

Stem diameter is a measure of stem thickness, typically measured at the base using a measuring instrument such as a vernier caliper. This parameter indicates the strength and development of plant tissue and reflects plant vigor or robustness. Based on the results of the ANOVA test, followed by the DMRT test , the results are presented in Table 1.

Treatment	Stem Diameter			
	1 MST	2 MST	3 MST	4 MST
control	126.1 b	127.5 b	128.9 b	130.2 b
5 grams per liter	129.9 a	135.7 a	141.6 a	149.1 a

Based on the results of the DMRT test on the stem diameter parameter, the 5 gr per liter treatment showed a significantly different effect compared to the control in each week of observation (1–4 WAP), which was indicated by the difference in letter notation in each treatment. The 5 gr per liter treatment consistently obtained the notation a , while the control obtained the notation b, indicating that the stem diameter in this treatment was significantly larger. The average value of the stem diameter in the 5 gr per liter treatment increased from 129.9 at 1 WAP to 149.1 at 4 WAP, while in the control the increase was relatively lower, namely from 126.1 to 130.2. These results indicate that the application of fertilizer with a concentration of 5 gr per liter is able to stimulate optimal stem diameter growth, which is related to the role of nutrients in supporting cell division and thickening of plant stem tissue.

Leaf Length (cm)

Leaf length is the measurement from the base to the tip of an active leaf, representing vegetative growth. This parameter is used to assess leaf size development, which is related to photosynthetic surface area and sunlight absorption efficiency. Based on the results of the ANOVA test, followed by the DMRT test, the results presented in Table 1 are presented.

Treatment	Leaf Length			
	1 MST	2 MST	3 MST	4 MST
control	126.1 b	127.5 b	128.9 b	130.2 b
5 grams per liter	129.9 a	135.7 a	141.6 a	149.1 a

Based on the results of the DMRT test on leaf length parameters, the 5 gr per liter treatment showed a significantly different effect compared to the control in each week of observation (1–4 WAP), which was indicated by different letter notations for each treatment. The 5 gr per liter treatment consistently obtained the notation a, while the control obtained the notation b, which indicated that the leaf length in this treatment was significantly higher. The average leaf length in the 5 gr per liter treatment experienced a greater increase from 129.9 at 1 WAP to 149.1 at 4 WAP, while in the control the increase was lower, namely from 126.1 to 130.2. This indicates that the application of fertilizer with a concentration of 5 gr per liter is able to increase the growth of leaf length optimally, which is related to the role of nutrients in supporting the process of cell elongation and vegetative growth of plants.

CONCLUSION

Based on the results of the research that has been conducted, the application of fertilizer with a concentration of 5 grams per liter has a significantly different effect compared to the control on all observed growth parameters, namely plant height, number of leaves, stem diameter, and leaf length in each week of observation . Thus, it can be concluded that the application of 5 grams of fertilizer per liter can increase plant growth significantly and better than without treatment (control).

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